# SPECIFICATION

## NAME OF THE INVENTION

ABRASIVE CLOTH DRESSER AND METHOD FOR DRESSING AN ABRASIVE CLOTH WITH THE SAME.

## FIELD OF THE INVENTION

The present invention relates to an abrasive cloth dresser used for removing clogging material or foreign matter in abrasive cloths when chemical mechanical polishing (CMP) is performed, and to a method for dressing an abrasive cloth with the same.

## DESCRIPTION OF THE RELATED ART

In the process of manufacturing a semiconductor silicon wafer substrate or a minute electronic circuit, such as an integrated circuit, on a silicon wafer substrate, CMP is generally performed in order to remove asperities and crystal defects present on the surface of the substrate. In the CMP, a wafer substrate is polished with an abrasive cloth formed of, for example, expanded polyurethane fixed on a surface plate of a polishing machine while an abrasive liquid called slurry is supplied to the abrasive cloth and both the wafer and the abrasive cloth are rotated, with the wafer substrate pressed against the abrasive cloth at a predetermined load.

The slurry is a suspension containing abrasive particles, such as iron oxide, barium carbonate, cerium oxide, aluminum oxide, or colloidal silica, dispersed in an abrasive liquid, such as potassium hydroxide, diluted hydrochloric acid, diluted nitric acid, aqueous hydrogen peroxide, or iron nitrate, and is appropriately selected according to the polishing speed and the types of wafer and polishing object on the wafer.

In the CMP, many wafers are polished with one and the same abrasive cloth, many times in some cases. As the number of CMP operations increases, shavings or the like removed from polishing objects or agglomerated abrasive particles are gradually embedded into minute holes in the abrasive cloth. Thus, clogging occurs, and, accordingly, wafer-polishing speed decreases. It is therefore necessary to perform the operation, referred to as dressing, of removing the surface of the clogged abrasive cloth to recover the surface roughness all the time or on a regular basis, thereby recovering the polishing speed. In this dressing, a tool referred to as an abrasive cloth dresser is used.

Abrasive cloth dressers using diamond abrasive grains have been studied because diamond grains are superior in dressing of abrasive cloths. For such a dresser, a method has generally been used in practice in which diamond grains

are electrodeposited on a stainless steel by nickel plating. Also, other methods have been proposed: one in which diamond grains are brazed on a stainless steel with a metal (for example, Japanese Unexamined Patent Application Publication No. 10-012579); and another in which diamond grains are subjected to reaction sintering with a support and, thus, allowed to adhere to the support (for example, Japanese Unexamined Patent Application Publication No. 2001-179638). In addition, in order to acquire a stable capability of removing the surface of abrasive cloths, CMP abrasive cloth dressers have been proposed (for example, Japanese Unexamined Patent Application Publication Nos. 2000-141204 and 2002-127017) in which abrasive grains are arranged in regular intervals.

In the above-described known abrasive cloth dressers, however, it is structurally inevitable that the state of the dressing face of a dresser exhibits individual differences in, for example, the end shapes of abrasive grains. Accordingly, it is difficult to give an abrasive cloth a uniform surface even if one and the same abrasive cloth dresser is used. In addition, the surface state of the abrasive cloth needs to be adjusted according to polishing objects. For example, for a silicon wafer having an oxide interlayer on its surface, the polishing speed of an abrasive cloth is increased by making the abrasive cloth

surface rough to enhance the mechanical removal capability. For Cu wiring, it is necessary for an abrasive cloth to maintain a predetermined surface roughness in order to enhance the chemical reaction capability to an abrasive liquid (slurry) present on the surface of the abrasive cloth rather than the mechanical removal capability. Therefore, a required number of abrasive cloth dressers need to be prepared and whose dressing face states must be suitable for polishing objects. Consequently, costs are undesirably increased.

## SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide an abrasive cloth dresser capable of adjusting its dressing face so as to give an abrasive cloth a uniform surface, or capable of giving the surface of an abrasive cloth a suitable polishing capability according to polishing objects, even if the dressing face state exhibits individual differences in, for example, the end shapes of abrasive grains, and to provide a method for dressing an abrasive cloth using the same.

To this end, the present invention is directed to an abrasive cloth dresser including a rotatable base metal having a dressing face on a surface thereof. On the dressing face, a plurality of abrasive grain units are

arranged in the circumference direction of the dressing face. The base metal has adjusters, corresponding to each or some of the abrasive grain units for adjusting the difference in height with respect to the dressing face between reference planes of the respective abrasive grain units. The reference planes are each defined by ends of the abrasive grains in the corresponding abrasive grain unit.

In the abrasive cloth dresser, the height difference between the reference planes of the respective abrasive grain units can be adjusted by the adjusters. Therefore, by adjusting the height difference between the reference planes of the respective abrasive grain units to condition the state of the dressing face, the dresser can give an abrasive cloth a uniform surface, or give the surface or polishing surface of an abrasive cloth a suitable polishing capability according to polishing objects, even if the dressing face state exhibits individual differences in, for example, the end shapes of abrasive grains. In this instance, the abrasive grain units with the higher reference plane contribute to abrasion of the abrasive cloth mainly, and the other abrasive grain units with the lower reference plane contribute to the adjustment of the surface roughness of the abrasive cloth.

Each adjuster may include a base different from the base metal. The abrasive grain units having the adjuster

are each bonded on the base and are arranged in a ring manner on the dressing face along the outer region of the base metal.

Preferably, the abrasive grain units are shaped, in plan view, in at least one form selected from the group consisting of a ring-fragment form parallel to the circumference of the dressing face, a spiral-fragment form having a predetermined angle with respect to the circumference of the dressing face, and a circular form. Consequently, shavings removed by dressing from abrasive cloths and agglomerated slurry are easily discharged from the dresser.

If the abrasive grain units are shaped in two forms, it is preferable the two types of abrasive grain units having different plan shapes from each other be alternately arranged in the circumference direction of the dressing face.

The abrasive grain units may be formed of grains with the same grain size, or two types of abrasive grains having different grain sizes from each other so as to define two types of abrasive grain units.

Preferably, the abrasive grain units includes first abrasive grain units and second abrasive grain units having different grain sizes from each other, and first abrasive grain units and the second abrasive grain units are alternately arrange in the circumference direction of the

dressing face. In this instance, each first abrasive grain unit may be formed of abrasive grains with the same grain size or two types of abrasive grains with different grain sizes from each other.

More preferably, the abrasive grains in each abrasive grain unit are regularly arranged in two dimensions, and adjacent abrasive grains form regular triangle or parallelogram minimum lattices. Consequently, the dressing stability and uniformity can be further increased.

The present invention is also directed to a method for dressing an abrasive cloth with the foregoing abrasive cloth dresser. In this method, a predetermined height difference is set between the reference planes of any two adjacent abrasive grain units by the adjusters.

If the abrasive grain units include the first abrasive grain units and the second abrasive grain units, it is preferable that the height of the reference plane of the first abrasive grain units be set larger than that of the second abrasive grain units by a predetermined amount.

In the method for dressing an abrasive cloth with the abrasive cloth dresser of the present invention, by arbitrarily adjusting the height difference between the reference planes of the respective abrasive grain units with the adjusters, the dressing face can be conditioned to be a desired state. Consequently, the abrasive cloth can be

given a uniform surface, and besides, the polishing surface of the abrasive cloth can be given a suitable polishing capability according to polishing objects.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A to 1D are perspective views of abrasive cloth dressers according to a first embodiment of the present invention, each having a different arrangement of abrasive grain units.

Figs. 2A to 2D are perspective views of abrasive cloth dressers according to a second embodiment of the present invention, each having a different arrangement of abrasive grain units.

Fig. 3 is a sectional view taken along line III-III in Fig. 1A.

Fig. 4 is a sectional view taken along line IV-IV in Fig. 2A.

Fig. 5 is a schematic representation of the arrangement of abrasive grains of a first abrasive grain unit 5.

Fig. 6 is a fragmentary enlarged view of Fig. 3.

## DESCRIPTION OF THE EMBODIMENTS

Figs. 1A to 1D show abrasive cloth dressers according to a first embodiment of the present invention, each having a different arrangement of abrasive grain units. An

abrasive cloth dresser 1 comprises a circular base metal 2 having a recess 2a at the center on its obverse side, and a dressing face 4 is formed in a ring shape on the base metal surface 3. On the dressing face 4, pluralities of first abrasive grain units 5 and second abrasive grain units 6 are separately arranged in a ring manner along the circumference direction of the dressing face 4. In other words, the abrasive grain units 5 and 6 are arranged in a ring manner on the base metal surface 3 along the outer region of the base metal 2, thus forming the dressing face 4.

Also, in order to arbitrarily adjust the height difference $\delta$ between reference planes S1 and S2 of the respective abrasive grain units 5 and 6, the base metal 2 is provided with adjusters 7, as shown in Fig. 3, wherein the reference planes S1 and S2 are defined by the planes including the ends of abrasive grains having the largest grain size in the respective abrasive grain units 5 and 6.

The recess 2a is not necessarily provided in the base metal 2.

Specifically, the abrasive grain units 5 and 6 are bonded on the respective adjusters 7, and each adjuster 7 includes base 7a embedded in a recess 7e being an opening provided in the surface 3 of the base metal 2, an adjusting screw 7b provided on the rear surface of the base 7a and secured in a screw hole 7c passing from the bottom of the

recess 7e of the base metal 2 through the rear surface of the base metal 2, and a spacer 7d disposed between the rear surface of the base 7a and the bottom of the recess 7e. The spacer is used for adjusting the vertical position of the reference plane of the abrasive grain unit 5 or 6 bonded to the base 7a with the adjusting screw 7b. Thus, the plurality of abrasive grain units 5 and 6, each bonded on the surface of the base 7a of the adjuster 7 are arranged in a ring manner along the outer region of the base metal 2, thus forming the dressing face 4.

By disposing the spacer 7d having a thickness sufficient to adjust the height of the reference plane S1 or S2 of the abrasive grain units 5 and 6 in the recess 7e of the base metal 2, the spacer 7d being held between the bottom of the recess 7e and the rear surface of the base 7a with the adjusting screw 7b, the vertical positions of the reference planes S1 and S2 with respect to the base metal surface 3, that is, the height difference $\delta$ between reference planes S1 and S2 of the respective abrasive grain units 5 and 6, are adjusted to condition the state of the dressing face 4. In the embodiment, the adjuster 7 can adjust the heights of the reference planes S1 and S2 with respect to the base metal surface 3 in the range of 0 to 300 $\mu$m.

The abrasive grain units with the higher reference

plane contribute to abrasion of abrasive cloths mainly, and the other abrasive grain units with the lower reference plane contribute to the adjustment of the surface roughness of the abrasive cloths. Specifically, the load imposed on the entire dresser intensively acts on the abrasive grain units with the higher reference plane. Consequently, the abrasive grain units with the higher reference plane contribute to the abrasion of the abrasive cloths. On the other hand, the abrasive grain units with the lower reference plane are subjected to part of the load to some extent to deduce the abrasive cloth dressing speed of the abrasive grain units with the higher reference plane. If the height difference $\delta$ between the reference planes increases extremely, the abrasive grain units with the lower reference plane do not achieve the effect of reducing the abrasive cloth dressing speed because it is subjected to no load. The abrasive grain units with the lower reference plane advantageously serve to discharge shavings of abrasive cloths.

The abrasive cloth dresser 1 includes the first abrasive grain units 5 and the second abrasive grain units 6. These two types of abrasive grain units 5 and 6 are respectively formed of different types of abrasive grins with different grain sizes from each other, and are alternately arranged in the circumference direction along

the outer region of the base metal 2, thus forming the dressing face 4.

Specifically, as shown in Figs. 5 and 6, the first abrasive grain units 5 are each formed of two types of abrasive grains 50 and 51 respectively having a large grain size and a small grain size. Theses two types of abrasive grains 50 and 51 are regularly and equally arranged in two dimensions on the surface of the base 7a, namely, the dressing face 4, and the minimum lattices defined by adjacent abrasive grains form regular triangles or parallelograms, as shown in Fig. 5. The intervals between the large abrasive grains 50 are larger than those between the small abrasive grains 51.

By regularly and equally arranging the two types of abrasive grains, dressing stability can further be increased.

On the other hand, the second abrasive grain units 6 may each be formed of abrasive grains with an identical grain size different from that of the first abrasive grain units 5 or a plurality types of abrasive grains having different grain sizes from each other. Preferably, these abrasive grains are regularly and equally arranged in two dimensions, as in the first abrasive grain units 5.

For the abrasive grains constituting the abrasive grain units 5 and 6, diamond grains may be used, and, in general, the grain size is preferably in the range of #325/#400 to

#60/#80 specified in JIS B 4130.

The first abrasive grain units 5 do not necessarily contain the two types of abrasive grains 50 and 51 with different grain sizes, and they may be formed of abrasive grains with an identical grain size (see the embodiment of Figs. 2A to 2D). Also, the adjusters 7 are not necessarily provided for both the first abrasive grain units 5 and the second abrasive grain units 6, and they may be provided for some of the abrasive grain units, that is, for either the first abrasive grain units 5 or the second abrasive grain units 6. In this instance, the base 7a of the abrasive grain units not provided with the adjusters 7 are directly fixed to the outer region of the base metal 2.

When the grain size of the abrasive grains is varied from one type of abrasive grain units to the other, or when abrasive grains with different grain sizes are mixed in each abrasive grain unit, abrasive grains with a larger grain size mainly contribute to abrasion of abrasive cloths, and abrasive grains with a smaller grain size contribute to the adjustment of the surface roughness of abrasive cloths. By controlling these grain sizes, the surface roughness of abrasive cloths can be conditioned to be suitable for CMP of a specific object.

In addition, the first abrasive grain units 5 and the second abrasive grain units 6 of the abrasive cloth dresser

1 may be shaped, in plan view, in at least one form selected from among a small circular form, a ring-fragment form parallel to the circumference of the base metal 2 or dressing face 4, and a spiral-fragment form having a predetermined angle with respect to the circumference of the base metal 2 or dressing face 4, as shown in Figs. 1A to 1D. Fig. 1A shows an example in which both the abrasive grain units 5 and 6 have a small circular form; Fig. 1B shows an example in which the first abrasive grain units 5 have a small circular form and the second abrasive grain units 6 have a spiral-fragment form; Fig. 1C shows an example in which both the abrasive grain units 5 and 6 have a ring-fragment form; and Fig. 1D shows an example in which both the abrasive grain units 5 and 6 have a spiral-fragment form. By arranging the abrasive grain units 5 and 6 having such shapes in plan view in a ring manner on the metal base surface 3 along the outer region of the base metal 2 to form the dressing face 4, shavings of abrasive cloths and agglomerated slurry removed by dressing can be easily discharged from the dresser and the capability of the discharge can be controlled.

In the abrasive grain units 5 and 6, the abrasive grains are held by the support 52, as shown in Figs. 3 and 6. The support 52 holding the abrasive grains are bonded to the surface of the base 7a of the adjuster 7 with an adhesive 8,

and, thus, the abrasive grain units 5 and 6 are fixed on the base 7a.

If the abrasive grains are formed of diamond, the support 52 may be formed of silicon or a silicon alloy that can reaction-sinter with diamond abrasive grains. However, it is not particularly limited as long as it can suitably hold the abrasive grains. For example, the abrasive grains may be held by nickel electrodeposition or bonding with a brazing material.

A method for dressing an abrasive cloth with the above-described abrasive cloth dresser 1 will now be described. A predetermined difference $\delta$ in height with respect to the base metal surface 3 is provided between the reference plane S1 of the first abrasive grain units 5 and the reference plane S2 of the second abrasive grain units 6 by the adjuster 7, and thus, the abrasive cloth is dressed. In other words, the height of the reference plane S1 of the first abrasive grain units 5 is set to be higher than the height of the reference plane S2 of the second abrasive grain units 6 by a predetermined amount $\delta$ by the adjuster 7, and, thus, the state of the dressing face 4 is appropriately conditioned. Thus, the surface of the abrasive cloth can be dressed to be a desired state according to a polishing object.

In the above-described abrasive cloth dresser 1, by

adjusting the height difference $\delta$ between the reference planes S1 and S2, the dressing face 4 can be conditioned so as to exhibit a desired abrasion capability. Consequently, the abrasive cloth can be given not only a uniform surface, but also a suitable polishing capability according to polishing objects, even if the state of the dressing face 4 exhibits individual differences.

Figs. 2A to 2D show abrasive cloth dressers according to a second embodiment of the present invention, each having different arrangements of abrasive grain units. An abrasive cloth dresser 10 of the present embodiment includes a plurality of abrasive grain units all of which are a first abrasive grain units 5. The abrasive grain units 5 are arranged in a ring manner along the outer region of the base metal 2 to form a dressing face 4.

The abrasive grain units 5 may be shaped, in plan view, in a form selected from among a small circular form, a ring-fragment form parallel to the circumference of the dressing face 4, and a spiral-fragment form having a predetermined angle wit respect to the circumference of the dressing face 4, as in the first embodiment. Fig. 2A shows an example in which all the abrasive grain units 5 have a small circular form; Fig. 2B shows an example in which the abrasive grain units 5 have different two shapes being a small circular form and a spiral-fragment form, and these differently

shaped abrasive grain units 5 are alternately arranged in the direction of the circumference of the dressing face 4; Fig. 2C shows an example in which all the abrasive grain units 5 have a ring-fragment form; and Fig. 2D shows an example in which all the abrasive grain units 5 have a spiral-fragment form.

Other parts, including adjusters 7 have the same structures as in the first embodiment, and the description is not repeated.

For dressing an abrasive cloth with the abrasive cloth dresser 10, a difference $\delta$ in height with respect to the base metal surface 3 is provided between the reference planes S1 of any two adjacent abrasive grain units 5 by the adjusters 7.

In the above-described abrasive cloth dresser 10, by adjusting the height difference $\delta$ between the reference planes S1 of adjacent abrasive grain units 5, the dressing face 4 can be conditioned so as to exhibit a desired abrasion capability. Consequently, the abrasive cloth can be given not only a uniform surface, but also a suitable polishing capability according to polishing objects, even if the state of the dressing face 4 exhibits individual differences.

The adjusters 7 are not limited to the structure described above, and the adjusters 7 may include various

mechanisms capable of adjusting the height of the reference planes of the abrasive grain units in the vertical direction within a narrow range.

An example of the dresser and dressing method with the dresser of the present invention will now be described with comparative examples. However, the present invention is not limited by the example.

[Example 1]

For the first abrasive grain units 5, diamond abrasive grains 50 with a grain size in the range of 150 to 170 μm, equivalent to the grain size of #120/#140, and diamond abrasive grains 51 with a grain size in the range of 55 to 65 μm, equivalent to the grain size of #325/#400 were used. These abrasive grains 50 and 51 were subjected to reaction sintering with a support 52 to prepare a sintered member held with the support 52.

In this instance, the two types of abrasive grains 50 and 51 were arranged such that the height difference between the plane including the ends of the abrasive grains 50 with a grain size of #120/#140 and the plane including the ends of the abrasive grains 51 with a grain size of #325/#400 was set in the range of 40 to 60 μm. Also, adjacent abrasive grains 50 and 51 formed regular triangle minimum lattices while the abrasive grains 50 with the grain size of #120/#140 were disposed at regular intervals of 2.0 mm and

the abrasive grains 51 with the grain size of #325/#400 at regular intervals of 0.4 mm.

For the second abrasive grain unit 6, diamond abrasive grains with a grain size in the range of 250 to 320 $\mu$ m, equivalent to the grain size of #60/#80, were arranged at regular intervals of 0.8 mm.

The resulting sintered members prepared as above were machined to predetermined sizes and shapes, and, thus, first abrasive grain units 5 and second abrasive grain units 6 were formed. Then, these abrasive grain units 5 and 6 were bonded to respective SUS 316L stainless steel bases 7a with a diameter of 100 mm of adjusters 7 with an epoxy resin. In the example, the first abrasive grain units 5 and the second abrasive grain units 6 had a spiral-fragment form having a predetermined angle with respect to the circumference of the dressing face 4, as shown in Fig. 1D.

an expanded polyurethane abrasive cloth rotating at a speed of 100 rpm was dressed with the resulting dresser rotated at a speed of 80 rpm in the same direction as the abrasive cloth and pressed against the abrasive cloth at a pressure of 19.6 kPa while an abrasive slurry containing fumed silica (SS-25, produced by Cabot) was being supplied at a late of 25 mL/min.

At this moment, the difference $\delta$ in height with respect to the base metal surface 3 between the reference plane S1

of the first abrasive grain units 5 and the reference plane S2 of the second abrasive grain units 6 was set at 15, 30, or 60 $\mu$m by the adjusters 7, and the dressing speed (abrasion speed for an abrasive cloth) and the state of the abrasive cloth (surface roughness of the abrasive cloth) were measured. Subsequently, the polishing speed of the abrasive cloth for a wafer was measured. The results are shown in Table 1.

In the example, the n value, namely, the number of samples, was set at 20 and the values shown in table 1 represent averages (Ave) obtained from the respective measurements. $\delta$n-1 values in Table 1 represent standard deviations obtained from the respective measurements. The polishing speed for wafers were measured, before and after polishing, with a wafer evenness meter (Ultragague 9800) produced by ADE Corporation, and an average polishing speed was obtained from the measured values.

[Table 1]

| | | | Example | | |
|---|---|---|---|---|---|
| Abrasive Grain Intervals | First Abrasive Grain Unit | #120/#140 | 2.0mm | | |
| | | #320/#400 | 0.4mm | | |
| | Second Abrasive Grain Unit | #60/#80 | 0.8mm | | |
| Height Differences Between Reference Planes $\delta$ ($\mu$m) | | | 15 | 30 | 60 |
| Abrasive Cloth-Abrasion Speed ($\mu$m/Hour) | | Ave. | 69.2 | 108 | 122 |
| | | $\delta$n-1 | 1.33 | 1.25 | 1.78 |
| Abrasive Cloth Surface Roughness Ra ($\mu$m) | | Ave. | 4.12 | 4.05 | 4.19 |
| | | $\delta$n-1 | 0.12 | 0.15 | 0.14 |
| Wafer-Polishing Speed (nm/min) | | Ave. | 126 | 129 | 121 |
| | | $\delta$n-1 | 6.7 | 7.2 | 5.6 |
| Scratching Occurrence (%) | | | 0.00 | 0.00 | 0.00 |

Table 1 suggests that the dressing face of the abrasive cloth dresser of the present invention can be conditioned to a desired state by adjusting the grain sizes of the abrasive grains in the plurality of abrasive grain units or the

height difference $\delta$ between reference planes of the respective abrasive grain units, and that, in particular, the abrasion speed varies greatly among height differences $\delta$ between the reference planes of the abrasive grain units. Thus, one and the same abrasive cloth dresser can achieve stable dressings of abrasive cloths under various conditions.

The results of the measurements suggest that the overall performance of the dresser is enhanced in comparison with the following comparative examples. Also, each of the standard deviations of the measured values is low, and this indicates that the variation in surface roughness between the resulting abrasive cloths becomes very small, and that the dresser can give abrasive cloths a stable polishing capability.

[Comparative Example 1]

An expanded polyurethane abrasive cloth was dressed under the same conditions as in Example 1, with a known CMP abrasive cloth dresser in which diamond abrasive grains with a grain size in the range of 210 to 250 $\mu$m, equivalent to the grain size of #80/#100, were arranged at regular intervals of 0.25 mm and fixed by nickel electrodeposition. The results are shown in Table 2.

[Comparative Example 2]

An expanded polyurethane abrasive cloth was dressed

with an abrasive cloth dresser under the same conditions as in Example 1. The sintered members of the abrasive cloth dresser were formed of diamond abrasive grains with a grain size in the range of 150 to 170 $\mu$m, equivalent to the grain size of #120/#140. The abrasive grains were arranged at regular intervals of 2.1 mm such that adjacent abrasive grains form regular triangle minimum lattices. The abrasive grain units formed of the abrasive grains were each shaped in a ring-fragment form, in plan view, parallel to the circumference of the dressing face, as shown in Fig. 2C. The results are shown in Table 2 with the results of Comparative Example 1.

[Comparative Example 3]

For abrasive grain units, diamond abrasive grains with a grain size in the range of 150 to 170 $\mu$m, equivalent to the grain size of #120/#140, and diamond grains with a grain size in the range of 55 to 65 $\mu$m, equivalent to the grain size #325/#400, were used, as in the first abrasive grain units of Example 1. These two types of abrasive grains were arranged such that the height difference between the plane including the ends of the abrasive grains with a grain size of #120/#140 and the plane including the ends of the abrasive grains with a grain size of #325/#400 was set in the range of 40 to 60 $\mu$m. Also, adjacent abrasive grains form regular triangle minimum lattices while the abrasive

grains with the grain size of #120/#140 are disposed at regular intervals of 2.0 mm and the abrasive grains with the grain size of #325/#400 at regular intervals of 0.4 mm. The abrasive grain units having such an abrasive grain arrangement were shaped in a ring-fragment form parallel to the circumference of the dressing face, and arranged on the dressing face along the outer region of the base metal, as shown in Fig. 2C, and thus an abrasive cloth dresser was formed. Then, an expanded polyurethane abrasive cloth was dressed with the abrasive cloth dresser under the same conditions as in Example 1. The results are shown in Table 2 with the results of Comparative Examples 1 and 2.

[Table 2]

| | | Comparative Example 1 | Comparative Example 2 | Comparative Example 3 |
|---|---|---|---|---|
| Diamond Grain Size | | #80/#100 | 120/#140 | ①#120/#140<br>②#325/#400 |
| Abrasive Grain Intervals | | 0.25mm | 2.1mm | ①2.1mm<br>②0.4mm |
| Abrasive Grain Holding Technique | | Electro-depositi-on | Sintering | |
| Abrasive Cloth-Abrasion Speed ($\mu$m/Hour) | Ave. | 61.6 | 189 | 138 |
| | $\delta$n-1 | 7.84 | 14.6 | 2.43 |
| Abrasive Cloth Surface Roughness Ra($\mu$m) | Ave. | 3.01 | 3.32 | 3.45 |
| | $\delta$n-1 | 0.36 | 0.36 | 0.13 |
| Wafer-Polishing Speed (nm/min) | Ave. | 105 | 98.3 | 120 |
| | $\delta$n-1 | 35.2 | 25.3 | 9.6 |
| Scratching Occurrence | | 0.52 | 0.00 | 0.00 |